The Thesis Committee for Kaiwen Fa
Certifies that this is the approved version of the following Thesis:

Polluted Playground

APPROVED BY
SUPERVISING COMMITTEE:

William Bloodgood, Supervisor

Sven Ortel, Co-Supervisor

Jason B Buchanan

Polluted Playground

by

Kaiwen Fa

Thesis

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Master of Fine Arts

The University of Texas at Austin

May 2019

Acknowledgements

Efforts were made to ensure all copyrights and citations are accurate. However, if any adjustments need to be made – I am happy to pursue correcting for the error. Please contact me with any such requests at kaiwenfadesign@gmail.com.

Abstract

Polluted Playground

Kaiwen Fa, MFA

The University of Texas at Austin, 2019

Supervisor: William Bloodgood, Sven Ortel

Our environment has been in great danger for the past 100 years. From air pollution to wild life habitat loss, the spectrum of environmental threats spreads across cities and jungles, affecting human beings as well as all life on the planet.

Many scientific researches have been conducted and their results have proven the existence of these environmental threats and the fact that we need to urgently take actions to resolve them. I have visited museums and read articles that attempt to visualize the scientific data through beautifully designed diagrams or maps to educate the general public about such urgency. However, while I understand these threats intellectually, after viewing the diagrams and visualizations, I often found myself not feeling the emotional urgency to act towards these threats. As a visual storyteller, I see this as an opportunity to investigate how to communicate the urgency of environmental threats in more emotional ways.

I was born in Ji Nan, which is a small city near the east coast of China. My childhood memories are filled with beautiful hills and hundreds of natural springs scattered around the city. Nature has always been close to me and yet something I take

for granted. As an artist who has always been obsessed with works that connect communities and advocate for social responsibilities, I want to make my contribution to solving environmental challenges.

I ask myself the following questions:

(1) How can I successfully translate scientific facts into emotional scenarios to engage audiences?

(2) How can I successfully utilize digital technologies to create an experience that feels accessible?

(3) How can interactivity be successful in visual storytelling in a live environment?

(4) How does a dome with spherical projection enable user engagement?

To answer these questions, I designed and produced an experience named “The Polluted Playground.” It is an immersive experience that featured a projection mapped geodesic dome. It utilized interactive digital graphics to engage its audience on an emotional level to communicate the urgency of environmental threats. At the end of the experience, I measured the level of success by asking my participants to answer an anonymous survey.

Table of Contents

List of Figures

Chapter 1: Introduction: *Background, Research, and Development*

PERSONAL BACKGROUND

I was born in a small city near the east coast of mainland China called Ji Nan. The city is famous for tens of hundreds of sporadic natural springs, thanks to its abundant underground water reservoir. Over the last 100 years, many of the springs were made into historical parks and scenery sites, decorated with traditional Chinese architecture or surrounded with curated gardens.

Even though my family led a typical working-class city life during my childhood, I had the privilege to grow up in close proximity to certain aspects of the natural world that are not always accessible to other urban citizens in China. One childhood memory that holds a special place in my heart is that of a natural spring right in the middle of downtown's busy traffic. It was named "The Black Tiger Spring".

Figure 1: "Hei Hu Quan" – The Black Tiger Spring in Ji Nan, Shandong, China

Source: http://t.sdnews.com.cn

There are nine tiger heads made from black marble sitting on top of nine individual spring sources. The spring waters streamed from the tigers' mouths. The water there was so clean and sweet that people carried their own vessels to fetch it for their household use, despite the supermarkets being close by.

My family migrated to Beijing when I was eleven years old, leaving all the natural springs behind for a metropolitan life. However, since then Ji Nan had reoriented its goals to pursue a more ambitious and financial-driven future. Unfortunately, those urban plans were later proven to be poorly designed and shortsighted. Through the years, I have witnessed the city's exploitation and neglect of its natural resources, and thereafter the degradation of its reputation as the "city of springs". The "Bao Tu Quan", or the "Spouting Spring", the most celebrated spring site of the city known of its perpetual spouts, has not flowed for years.

Figure 2: "Bao Tu Quan" – The Bao Tu Spring Garden in Ji Nan, Shandong, China

Source: http://k.sina.com.cn

Meanwhile, after I came to the United States for college, air pollution really started invading into the domestic lives in major cities in China. While I luckily avoided the smog and the dust particles by staying under the Texas sun, my family has had to bear the threats to their health everywhere in the air.

As someone who has lived most of his life in cities, protected and isolated from environmental threats by a filtered infrastructure, taking living necessities such as clean water for granted, I had not yet fully come to the realization about the scale and the urgency of the environmental threats until the consequences spread into my personal and my family's visceral territory, despite being educated on a regular basis about environmental problems and concerns through the mass media and in school.

As an artist and designer, I anchor my work around issues that are relevant and prevalent in our society. I try to build environments or platforms to bring issues I think that are valuable under the spotlight, facilitate open exchanges of ideas, and evoke more thoughts or actions among my audience. Environmental threats are the biggest challenge for ours and the next generation, and it takes collective efforts from every member in our society to resolve these threats. I believe in order to evoke people to take actions on these threats, not only that they need to understand these threats intellectually, but also they need to find the personal connection to these threats and internalize how these threats will and have already affected them and others on an emotional level. Art, in my opinion, is a great tool to achieve such emotional influence, and I see an incredible value in creating work that can can potentially encourage more actions from people to resolve environmental threats.

DESIGN RESEARCH – RESEARCH ON THE TOPIC

RESEARCH ON RELEVANT ART PROJECTS

After I decided to focus my thesis project on using theatrical and artistic devices to communicate the urgency of environmental threats to urban populations, I started my initial research on how environmental threats are currently communicated to the general public. I also investigated how relevant art projects have dealt with this concern. I discovered this online digital library/archive documenting environmentally related art projects:

https://artistsandclimatechange.com/

This database covers a relatively long period of time, a wide variety of works in different media and fields and works executed in different parts of the world in various scales. Most important to me was the fact that this database categorizes the selected artworks by their medium – whether they are sculptures, paintings, or video/audio performances. Through this database I discovered two things that helped me define the potential value of my thesis project Polluted Playground: 1. Many successful and well publicized artworks that address environmental threats take the form of installations. 2. Within the category of digital art, there are not yet many widely recognized projects. The latter came as a surprise to me.

Referencing the first discovery, I see a few possible reasons that may explain artists' tendency towards installation: While an art installation may not be as easily accessible as it would be on a digital platform like YouTube, the physicality of an object or environment existing in a concrete location inherently offers a multi-dimensional

experience. People experience environmental threats in a multi-dimensional or multi-sensory manner: the pollution of water is as much about the visual as about the smell and the taste; climate change is as much about the temperature of the air as about the effects that manifest themselves visually and physically, like seeing the melting of the iceberg. Therefore, by offering a multi-dimensional experience, installation artworks can engage their audiences by multiple means and therefore communicate the complexity of the outcomes of environmental problems well.

To the second observation, I see it as an opportunity for me as a media artist to step up. I examined the listed and categorized media projects on the topic of environmental threats:

https://artistsandclimatechange.com/tag/digital-media/

Inevitably, since I did not witness any of the three mentioned projects in person, any evaluations I make are limited to what I can observe though the provided documentation. However, I am confident of these observations:

There are very few projects that use projection mapping or interactive digital media as the medium, despite the general popularity of them in the art world as digital mediums or story-telling devices.

The projects that do utilize digital media communicate abstract ideas, but not in ways that are as intuitively understood by the general public as some of the physical installations. I will compare two projects as an example:

Figure 3: *Dérive* by François Quévillon *Source: http://francois-quevillon.com*

Figure 4: *Minimal Monument* by Néle Azevedo *Source: http://www.feeldesain.com*

Both projects, one more digital, the other more physical, address one threat that is related to climate changing – the melting of glaciers/natural ice due to the overall rising

of the temperature. However, when I compared the visual documentations of both projects, *Minimal Monument* seems more direct and intuitive, and the underlying message for the project was communicated in a faster and therefore more effective way. It relates the consequence of the melting of the glaciers directly to its threat to our lives and stirs our visceral senses by metaphorically endangering our future generations. Compared to *The Changing States of the World*, *Minimal Monument* speaks a more easily understood language for the general audience by associating the environmental problems with our own well-being.

These observations made me think and eventually decide to focus my thesis on creating a digital-physical experience that combines the immediacy and the intuitiveness of a physical installations and my specialty in projection mapping and interactive media design.

What do I think media can contribute to successfully to this project? To me, the first and most obvious one is the technical spectacle and its inherent relevance to our time. Our current era is defined and shaped in so many ways by the advancement and popularity of digital technology. Smart phones, internet, video games, YouTube videos, and other forms of digital media platforms and digital content have been occupying the daily lives of urban populations around the world on a fundamental level. Digital spectacles have been huge attractions in the entertainment field – from large scale projection mapping to new video games. When digital media is used in an intuitive and entertaining way, it naturally attracts a lot of attention from the urban population, which is the target audience for Polluted Playground.

Meanwhile, projection mapping itself has many unique strengths when it comes to storytelling.

The most interesting part for me about digital content is how much freedom it provides to artists when it comes to its ability to allow for interactivity. That is important to me because I believe that interactivity can potentially create new ways of engagement by offering audiences agency over the story they are experiencing.

In summary, after this research I knew that the digital experience I needed to design for this investigation had to be (1) intuitive and immediate, (2) should utilize the strength of projection to transport audience into different spaces, and (3) needed to be interactive in a way that can successfully engage the audience.

From there, I arrived at a point that I felt I needed to commit to an approach for me to move forward. After consulting with a number of my faculty members and fellow students, I concluded that the next step for me was to pick what environmental threats I needed to cover in this project.

PICKING THE PROBLEM

The first step I made when researching what environmental problems I needed to address was consulting my friend Dr. Binbin Li, who is a professional environment scientist and advocate for environment protection. I approached her to ask what she thought about my thesis idea, what efforts she had observed in her field to promote and address environmental threats to the public, and of course, which environmental threats she thinks are most urgent to address. She provided several insights that I found very

helpful. She told me that while environmental problems encompass a wide range of issues and challenges, it is important to think about where my installation is going to take place geographically and where my audiences come from. She emphasized to me that, for example, since I am in Texas, if I want to talk about overhunting, it is better to frame my installation to encourage a more sustainable way of hunting as opposed to accusing hunting in general, because hunting as both a recreational and sometimes live-supporting activity has been an essential part of Texan culture. She mentioned that since I am living in Texas, I can either talk about an environmental problem that is very close to the local community or talk about something that is more prevalent and try to establish a connection between that problem to human society. For example, she said, while the picture of a dying polar bear struggling to find a piece of ice large enough to support its weight in the middle of the ocean evokes sympathy, it is more effective, and most importantly, more impactful for people if we show how the decrease of the polar bears' habitat affect our daily lives.

Dr. Li also suggested that one way for me to measure the level of success of my installation would be to offer my audience a simple choice at the end that is related to the environmental problem(s) I addressed. For instance, if I talk about the problem of air pollution due to overuse of fossil fuel, I can offer them at the end a link to register for public bike service (such as Austin B-Cycle) and see how many of my audience register after seeing my installation.

I also asked Dr. Li if I should encompass multiple environmental problems in my installation or focus on one. She suggested the latter because she thinks that it is better for

me to unpack and really explain one problem to my audience as opposed to touch on multiple problems without digging deep.

As I was talking with Binbin for scientific consultation, I also called my friend Tongqi Wang, who is a close friend of mine living in Chicago, a studio artist focusing on installations and media art. He and I have known each other for a long time, and I trusted that he would offer me more personal advice based on how well he knows me. Also, I found his work oftentimes has very clear themes and intentions, which is also what I want to achieve for my project.

He suggested that I should focus my installation on the environmental problem that I feel most connected with or I care about the most. Even though hunting may be a very relatable topic in Texas, he thinks that if I do not share that part of the culture and do not have experiences in hunting, not only I will have way less accountability when talking about it, I will also find it very difficult in creating the art based on only second hand research and interpretation, without personal connections.

After my conversation with both my two friends, I started the topic selection process by writing down a number of environmental problems with which I feel more connected. Air pollution is a big one since I and especially my family are the direct victim of the smog in Beijing. Water pollution is another one, since I have witnessed polluted water resources in all the cities I have lived in, and water itself is such an essential part of human lives. I also feel very connected to the problem of plastic pollution in the ocean, as I was very shocked when I learned how much plastic waste has been dumped in the ocean, and the fact that through the years it has decomposed into

micro-plastic particles that eventually could go back into to our own bodies through the food chain.

Even though air pollution is close to me, to many Americans, especially Texan, it is not a major concern in their life, since Texas in general has a very good air quality. I figured that if I had persisted in addressing the problem of air pollution, I will then be articulating a problem that is happening somewhere else. I want to address an environmental problem that is as universal as possible so that most people, including me and my audience, can relate to.

Water pollution is more universal. The causes of water pollution are both many and, most importantly, happening on industrial and farming levels. While it is a fundamental threat that effects everyone, I think it is hard to persuade individuals to take actions in their daily lives without addressing larger changes such as industrial waste regulations for mass production. What I want to talk about in this project is something for which we are all responsible and where everyone can take effective, direct action to improve.

Hence, I decided to choose the problem of plastic pollution in the ocean. It is large scale, it affects everyone, and especially the urban population who constantly use plastic products, and oftentimes avoidable single-use plastic products (water bottles, plastic utensils, etc.). Every urban citizen shares the guilt and there are plenty of everyday things can be done to improve this problem.

RESEARCH ON PLASTIC POLLUTION

From there I started to research about the plastic pollution in the ocean. Specifically, I want to find out about three things: What kind of plastic products are in the ocean? How do they end up in the ocean? And what are the consequence of this problem?

One of the major resources I used for my research is the website PlasticOceans.org, created by Plastic Oceans International, which is a non-profit organization based in California that has been actively researching, advocating, and educating the general public about the ocean plastic pollution and what we can do to help. Based on the research and data on this website, I found a few facts about ocean plastic pollution:

We use about 20 million plastic water bottles per day;

We produce about 300 million tons of plastic per year;

It takes 3 liters of water to make a 1-liter plastic bottle;

Over 8 million tons of plastic are dumped in our oceans every year;

The average useful lifetime of plastics is 12 minutes;

50% of all plastic is single-use;

I also found the answers for my three questions with more in-depth research. There are two common sources from which ocean plastics originate: land-based source and ocean-based source. The land-based source "includes litter from beach-goers, as well as debris that has either blown into the ocean or been washed in with storm water runoff. Ocean-based source "includes garbage disposed at sea by ships and boats, as well as

fishing debris, such as plastic strapping from bait boxes, discarded fishing line or nets, and derelict fishing gear."

In terms of the consequences of the ocean plastic pollution, first of all, plastic products will be ingested by marine life and birds and kill them since they cannot be digested. Second, toxic waterborne chemicals attract to plastic "like a magnet," and once these toxic plastics are eaten by birds or other marine lives, the toxin will travel along the food chain and eventually reach human population. 60% of the world's population relies on fish as their main source of protein, and these toxins can cause "cancer, autoimmune disease, cognitive problems, infertility and endocrine disruption." Meanwhile, because plastic is almost indestructible, "every item of plastic that has ever been created is still with us on the planet today." Therefore, the pollution we have today will remain and only keep accumulating if we do not take any action.

Chapter 2: The Design Process

The Team

Since the beginning of my thesis project, I knew that I would be putting on the hats of the producer and the artistic director and that I would leave the more specific design and execution to my team of collaborators. Moreover, the scope of my skill sets in relation to those of my collaborators would guide the design, workflow, and execution of the project. Therefore, what the project is finally going to be would depends on the inputs and skills of my teammates. I decided to reach out and search for collaborators early in the process around April 2018, which is about approximately eight months before the project opened.

I started my team assembly process by first considering what team members I would need, taking into consideration the importance of both the physical and digital content. I know I would need a set designer/set dresser with knowledge and experience in building a physical environment. I also would need a lighting designer and a sound designer in order to expand the experience for the installation into other senses and design languages. Finally, in terms of the digital technical challenges, I would need someone who has (1) proficiency in TouchDesigner, (2) a certain knowledge in game engines and 3D graphics, (3) an understanding of how digital interactivity with sensors works.

At the same time, I also considered what kind of team dynamics I would want to establish – what kind of collaboration and what kind of atmosphere I would want my

team to have, since I expect that would also determine the process and very likely the outcome of this project. I really aimed to make my thesis project an open and enjoyable process for my collaborators and make them feel like they are welcome to make creative decisions. I wanted creative and articulate collaborators. Communicators who were not afraid of challenging each other in a relaxed and respectful way.

The first two people I reached out were Griffin Hanson and Rogelio Bautista. Both are undergraduate students from the Department of Arts and Entertainment Technology (AET). Griffin at that time had been working with me for a while, and we had developed a good friendship. He was my assistant for the opera I designed in October 2017. I found him very knowledgeable and a fast learner in many areas including moving lights programming, TouchDesigner programming, general coding, and digital music composing. I also really appreciate the humor and laid-back attitude he carries with him, which I think can be a good addition to the group dynamic. I chose Rogelio even though I had not worked with him before. We had shared several classes together, and he has been demonstrating high quality work in TouchDesigner backed up with well-thought-out design ideas. I also found him very open for giving and receiving critique.

Griffin ended up volunteering to design both the lighting and sound, and Rogelio expressed that he wanted to work on content creation as well as creating a custom playback system inside TouchDesigner.

Time moved forward to September. Along With the beginning of a new academic year came the new first year design students. I had the opportunity to find the rest of the team. I ended up reaching out to one of the new Integrated Media student, Michael

Bruner, because he has a very strong background in game development and a good amount of knowledge with Unity 3D, which is a major game engine software that allows complex 3D graphics being rendered in real-time. He has shown a great amount of creativity in his work. Throughout my conversation with him, I found him very humble and easy-going, in spite of his knowledge and achievements. So I invited him on board without hesitation.

For my scenic designer, I reached out to first year scenic designer Chris Conard. Chris had at that time already promised to help my MFA colleague Iman Corbani on her thesis. Nevertheless, he did offer to help me on the building of the physical structure.

Design Concept

How We Landed Our Concept

My team and I started with our goal: to evoke an emotional response and further encourage actions in the audience around the problem of plastic pollution in the ocean, through an immersive experience with interactive digital media. My training in theater informed me that emotional responses are evoked when the audience find something that they can relate to intellectually, viscerally, and personally.

What kind of experience to me feels immersive? Why do I want to create an immersive experience? Those were two fundamental questions I asked myself at the very beginning.

To me, the sense of immersion happens on two levels. The first happens on the sensory level. It is when an audience or a participant is fully surrounded by a designed world. Examples can be a digital Virtual Reality experience inside a VR headset, or a fully designed experience that is isolated from the outside world like a haunted house. By isolating an audience member from his usual world and surrounding him fully with designed elements, artists can convince and transport the audience member temporarily into a world they designed.

The second level happens on the storytelling level. To create a fully immersive experience is to temporarily convince an audience member that they are not in the world they usually reside in, not in the reality that they are most familiar with, but in another unfamiliar, adventurous world that is crafted by the artist. This convincing illusion can be sustained when the audience member finds something engaging in the experience. Stories are one of the greatest tools to create engagement. In the theater or at a film, even though they are sitting in a dark box watching a screen or a stage, they can feel that we are right there in the fictional world with characters when we find the story engaging.

Why do I want to create an immersive experience? When an audience is immersed in the experience and engaging with the story, they establish an emotional connection with that experience. It is also the moment that the experience can potentially have a more profound impact on the audience member once it is over. Movies and theater performances that make us forget about time or make us cry are oftentimes the ones that keep hovering in the back of our mind, the ones we learn something from. In my case, I want to communicate and evoke emotional urgency of environmental threats on an

emotional level in my audience. Creating an immersive experience can help me achieve this goal.

When I compared the two levels of immersion, the story to me is the more important and fundamental one. The story can inform the physical structure, and the physical structure at the end of the days should manifest the story. Therefore, I started off by thinking about what story I want to tell in this experience.

To help me and my team to have a starting point for story development, I decided to employ Joseph Campbell's monomyth, also known as "The Hero's Journey" as the underlying guide.

I first encountered the theory of "The Hero's Journey" from my playwright mentor in high school. My most recent example of it being put into practice was when I helped Jon Haas, a former Integrated Media graduate student in my program, on his thesis, where this particular narrative structure actually played a major role. The visual representation of "The Hero's Journey" is usually represented by a circular diagram like this:

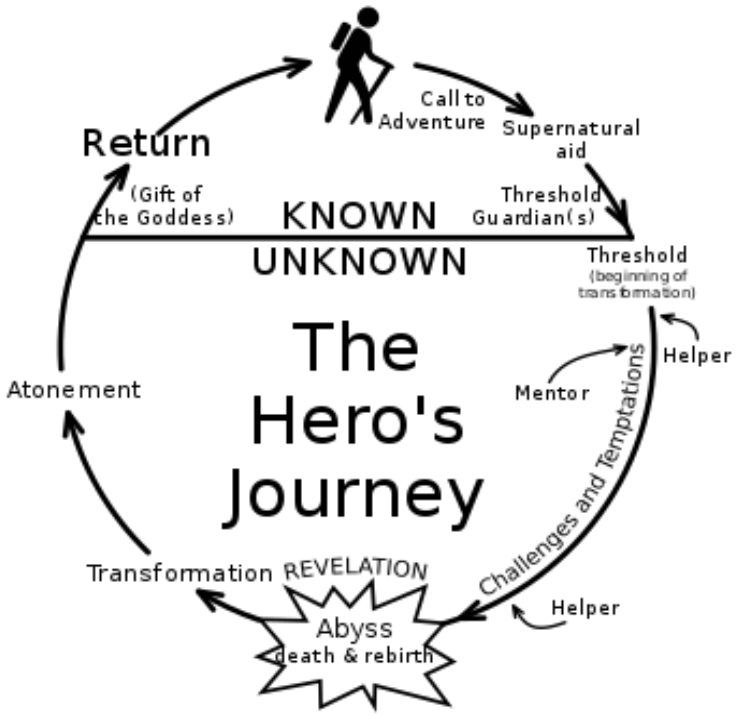

Figure 6: A diagram visualizing The Hero's Journey *Source*: *Wikipedia*

According to Campbell himself, the Greek mythology represents the common and fundamental backbone of a lot of western stories, from Greek tragedies to modern plays and TV series. It is not something invented by him, but rather a pattern he had discovered and extracted by analyzing hundreds of successful stories. Since the revelation of these themes many playwrights and screenwriters have used it as a tool to help them generate stories that can be engaging to audiences.

Depending on the length or the complexity of the narrative, not every part in the "The Hero's Journey" arc can be found in every manifestation of the concept. However, the core idea is that a protagonist starts off from a world they are familiar with or feel safe in. The "Hero" then passes through a threshold into a world that challenges them. As

they go through the challenges, they come to the major challenge, and get defeated (or die). The defeat changes the protagonist, making him or her discover something about the world and about themselves. With this new discovery, the protagonist is then reborn, and is able to overcome the major challenge, and return to their known world.

With this template in mind, I started with the question "who is the protagonist?" I wanted my audience to have a strong personal connection with the story, and most importantly, to have agency in the experience. Therefore, I decided that the audience should feel that they are the protagonist. To accomplish this, I considered two options: either the audience experiences the story from their own perspective (they are who they are in reality), or they are experiencing the protagonist's story from a first-person-perspective (they are someone else). I decided that the key to answer this question would be to answering this question would be to determine who my audience is going to be, and how much I should craft the experience to any specific audience group (ex., if my audience are mostly Texans, should I focus my story more about local plastic pollution in Texas?). I wanted my project to be as universally relatable as possible, so I did not want to adjust the content to address any specific audience group. Therefore, I decided to take the second route, which is to have my audience experience the story from a set perspective:

Whose perspective that would be then? Since I am focusing on plastic pollution in the oceans, it would evoke the strongest emotional response if the protagonist was the most immediate and most impacted victim of this pollution. So naturally, I thought about

the marine life, and to tell the story of how marine lives are being affected by the plastic pollution.

I then brought up this same question to my collaborators and received a different answer. My teammates pointed out that while the sense of sympathy can be evoked by showing how marine species are affected by plastic pollution, the sense of urgency will be much stronger if we, the human beings are the victims at the end, which corresponded to the advice I got from my environmental scientist friend Dr. Binbin Li.

Facing this dilemma, I took a step back and reflected on the process I and my team had taken. I noticed that until this moment both I and my team had been taken a very analytical and logical approach in designing this project. One of the things I learned in graduate school is that sometimes approaching a design from an aesthetic point of view could also help. I reached out to Mingxiang Ya, another Integrated Media graduate student in my group, and shared my dilemma with him and asked for his opinion, because Mingxiang has a very well-developed sense of aesthetic and a strong artistic vision.

Mingxiang encouraged me to think about the concept of a journey in a broader sense and suggested that I do not have to stick to one perspective explicitly in order to offer my audience a relatable and coherent experience. Instead, he suggested that the coherence can be communicated through visual elements such as color palette and graphic styles. He also suggested that the perspective from which the audience will experience this installation does not have to be consistent throughout. It can shift in between different perspectives. The important thing is to evoke emotional response and perspective is not the only tool to achieve that. He suggested that I can tell the story from

one perspective in the dome, and shift to another perspective in other parts of the experience, as long as I have one thing that guides my audience through that is consistent, which is the plastic. He suggested that I can craft the journey of the installation by following the journey of plastics. I found his suggestions very useful and decided to go with that.

Therefore, the final concept was this: the visitor to this immersive experience will follow the journey of plastics – from how they are being manufactured, celebrated, and disposed of within societies and habitats, to where they end up; far away from towns and cities, into the ocean, and eventually back to human habitats.

With this concept as a guideline, my team and I started to design the physical structure that would embody this concept.

SPACE & SET DESIGN – WHY A PROJECTION MAPPED GEODESIC DOME

Having decided the story, my team and I then moved on to investigate how to manifest our story through a physical structure and achieve the sense of immersion as well as a high level of audience engagement.

As mentioned before, I think a physical environment that separates the audience member from their outside world and surrounds them with design elements can be a helpful way to create the sense of immersion. As a media designer, I expected a major part of the design elements to be digital content. A physical environment that surrounds audience with digital content – a projection mapped geodesic dome is exactly that. Also, looking at "The Hero's Journey", the geometry of a geodesic dome can be an activating

agent: without any edges to orient themselves inside the dome, an audience member can find the inside of the dome an "unknown world", just like in "The Hero's Journey."

Which part of "The Hero's Journey" I should assign the geodesic dome to be? Looking at existing projects such as the *Antarctic Dome* by Obscura Digital, A projection mapped geodesic dome can be very powerful in creating sensory and emotional impact on audience members.

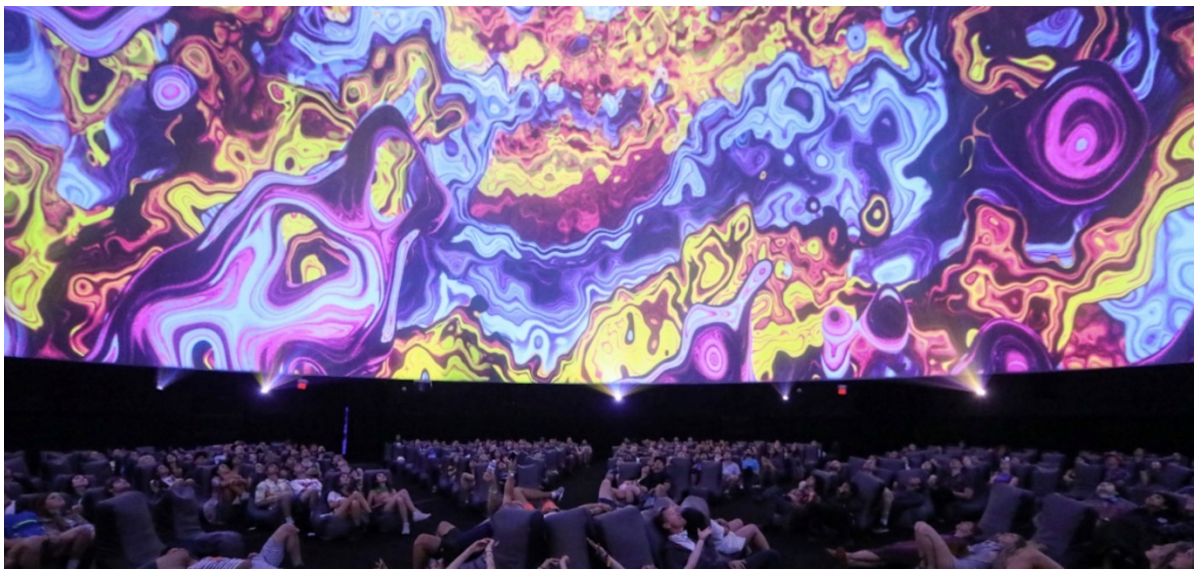

Figure 7: *Antarctic Dome at Coachella 2017* *Source: Obscura Digital*

The most powerful moment in "The Hero's Journey" is the "death moment". Therefore, I decided to reserve my geodesic dome to this moment.

Going from there, the next challenge was for my audience to be able to walk in and out of the dome. Considering that I wanted the overall experience to be linear, I expected that I would need two openings in my dome, one functioning as the entrance and the other as the exit. To fulfill the parts in the narrative that are before and after the

plastic enters the ocean, there would need to be a part that leads to the entrance of the dome, and some other parts that greet the audience when they exit the dome.

Tunnels seemed to be a great way to achieve this, since they fully surround whoever that is in them, and separate them from anything outside the tunnel. Therefore, I decided that to have two tunnels, one as the entrance leading into the dome, and the other as the exit.

As I was making decisions for what physical elements I would include in my installation, I also kept in mind of the limitation I had for my space. First of all, since this project was self-funded, I had to take into consideration the type of material and how much of it I would be able to afford, and how much I and my team would be able to treat and alter the materials. Secondly, the dimensions of my venue, the PLAI Lab (see the ground plan later in this chapter), needed to be considered as well. PLAI Lab is a lab space dedicated to the Projection, Lighting, And Interactivity (PLAI) students in the School of Arts and Entertainment Technology and the Integrated Media students in the Department of Theater and Dance. It is in the Texas Performing Arts Building. While it is an ideal space for prototyping media projects, as it features a support infrastructure for lighting and projection, the space itself, is also a classroom and classes were held during the time this project went up. This meant the entire footprint of this project needed to be controlled within a range that allows class activities to happen on the teaching side of the room as well as my combine installation (see site picture below).

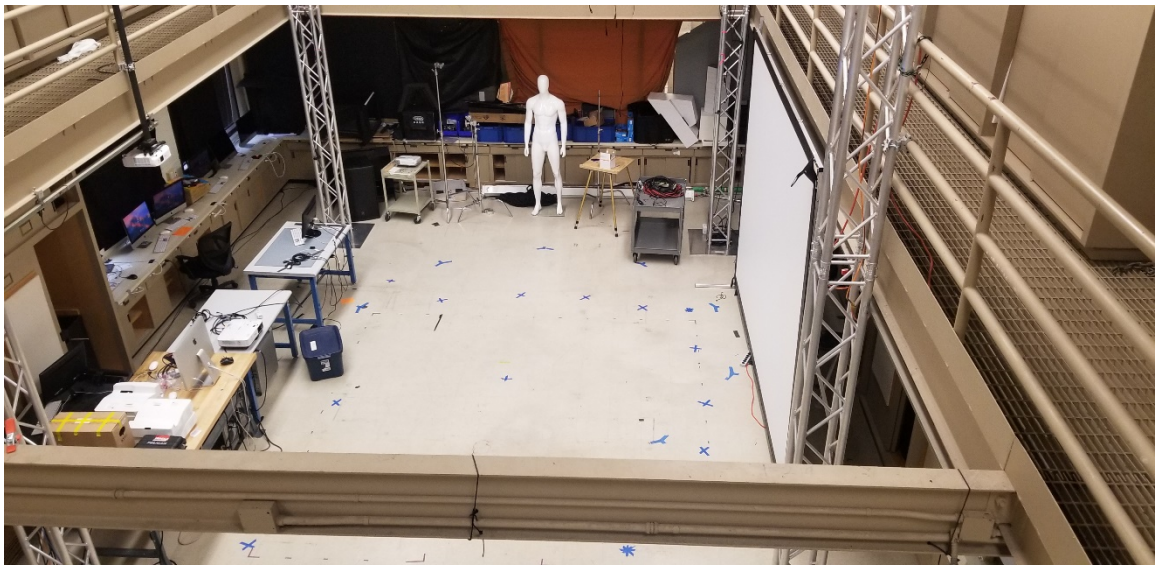

Figure 8: Projection, Lighting, And Interactivity (PLAI) Lab *Source: Kaiwen Fa*

Through my research into the construction geodesic domes, I found a kit named "hubs" that is designed by the British company "Build With Hubs", which turned out to be perfect for my application. This kit was also used in the project *Pollution Pods*, done by British artist Michael Pinsky. What is unique about this kit is that it contains only connectors that can be screwed into any wooden supports, and it comes with intuitive schematics and tools that help the user figure out the length of the sticks depending on the desired size of the dome.

As previously mentioned, a projection mapped dome, comparing to the VR experience inside a headset, can be more collective and social. Keeping this in my mind, I knew my dome would need to be big enough to comfortably accommodate at least 3 people standing upright. After I tested that parameter in a technical drawing, as well as maximize the structure for the size of the PLAI Lab, I concluded that the ideal size for my dome was 14 feet in diameter.

At this stage, which was around November 2018, less than two months till the installation opened, a preliminary plan for my physical structure appeared in my mind. I started to put it into Blender (a software for 3D modeling and animation) to get a sense of how the dome along with two tunnels would look like in the PLAI Lab:

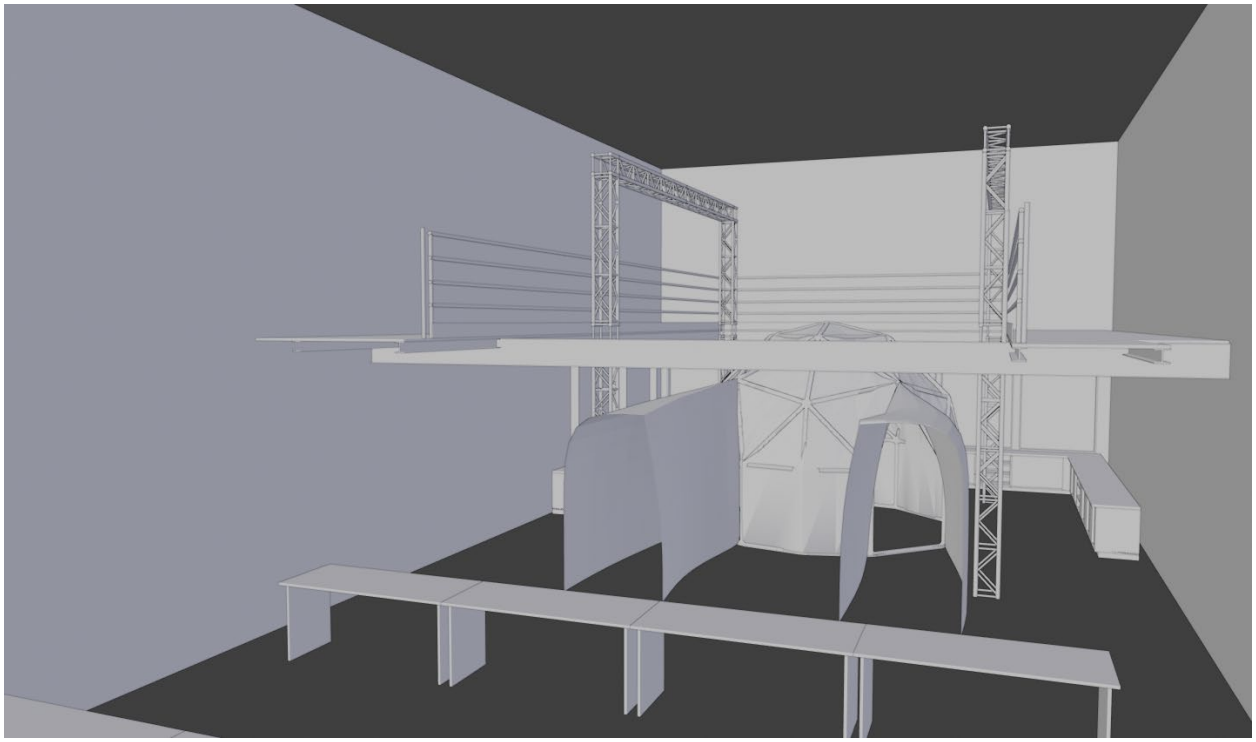

Figure 9: Preliminary Set Previsualization in Blender *Source: Kaiwen Fa*

CONTENT DESIGN

Having determined a preliminary physical structure, the next step for me was to determine what kind of content, physical or digital, I want to put inside this structure.

The entrance tunnel would depict the first part of the journey: how plastics are produced and disposed of, and how they transfer from human hands into to the ocean. To

contrast and enhance the power of the digital dome projection at the climax, I wanted to keep the entrance tunnel relatively simple, smaller scale, and also explore using some physical elements as my visual languages. My teammate Rogelio Bautista suggested that we introduce footage of common plastic advertising, to show how plastic products are celebrated by human society and how they have become a huge part of our daily lives. In the meantime, I also decided to project footage of plastic being disposed of, accumulating into countless piles, which is the first stage of the stage where they start to exit human habitats and impose negative impacts onto lives and environments.

The narrative created another design challenge: how do I communicate the huge scale of the problem? How do I create the impression of the plastic products floating in the ocean and spreading across thousands of miles inside my very limited space? These were the questions I faced in the next part of my entrance tunnel. For this, I took inspiration primarily from the art installation *Plastic Ocean* by Tan Zi X, in which different disposed plastic products were repetitively suspended in such a way that the installations completely engulf their audiences:

Figure 10: *Plastic Ocean* by Tan Zi Xi *Source*: *The Straits Times*

With the help of both lighting and the resulting shadows, these installations were able to successfully suggest to their audiences that what they are experiencing spread beyond the installation into a larger space. It is obvious that these installations were trying to evoke the feeling of being engulfed by plastic products, which is first and foremost from the marine lives' perspective, and that corresponds to my narrative structure. On the other hand, I did not want to employ projection and other digital content before the audience enters the dome in order to maximize the contrast between the experience inside the dome and outside the dome. I believed by creating this contrast, I could further enhance the impact of the dome projection has upon my audience.

Therefore, I had the idea of hanging small plastic parts off the ceiling of the tunnel, to the height of eye level, which made my viewers either have to bend their bodies or move the plastics around in order to make their way through the through the tunnel and into the dome and make their way through.

Then the dome: This is the part of the journey where the plastic pollution should reach its peak and it should have direct impact on my viewers and cause a certain kind of "death event", as outlined in "The Hero's Journey". "Death" here could be very metaphorical. What it essentially means is a moment where the protagonist faces the ultimate challenge in their journey and got defeated. This defeat "kills" the protagonist by forcing them to realize that they need to fundamentally change themselves in order to overcome this ultimate challenge. It requests them to take a step back, reflects on themselves, and accepts their vulnerability. Only after going through the painstaking self-reevaluation, the hero will be reborn as a new self and defeat the challenge.

In order to make the moment feel like a defeat to my audience, I figured there needed to be some kind of battle for my audience to fight in the first place, some goal that they are encouraged to achieve but only later realize that it is unachievable. I realized then that this moment would be a great opportunity to involve some interactive technology or gaming mechanism, so that I can treat the dome part of the narrative as a game and offer my audience a goal to achieve.

What can be the ultimate challenge here? The audience has reached the ocean, the level of plastic pollution needs to be overwhelming, and the audience should feel that sense of overwhelming. If overwhelming here means something is so strong or so great in

amount that it surpasses someone's capability to deal with it, then I should let my audience try to deal with the pollution first. That was how the idea of having the plastic trash piling up over the audience, and as the audience trying to clear the trash away, they realize that the amount is too much that they will eventually be buried under the pile.

My team and I went through several ideas of how the action of clearing the trash can be realized and what interactive mechanism we should use.

We first investigated into what technology we could use to allow the audience to clear the digital trash in the projection. We wanted to keep this technology as accessible and intuitive as possible to all our audience member, so the illusion of immersion will not break by audience member, for example, having to figure out what buttons to push on a controller. Michael Bruner worked with Leap Motion before, and Leap Motion is a technology that uses a small inferred tracker to detect bare hand movement.

Figure 11: Leap Motion Technology *Source: http://lumointeractive.com*

We had the idea of offering the audience a target where they can grab a trash piece and throw at the target, and it will disappear (sort of like a trash can). However, we tested the grabbing mechanism in Unity and realized that it will take too much time for us to get the grabbing mechanism right. Considering the time and technological limit we had, we decided to make the interactive part as simple as possible – only offering the audience an ability to move the trash around so they can clear away the pieces that fall directly onto them. We adjusted the speed and the amount of trash falling in Unity and got to a point that ensures the pile of trash will engulf the audience and completely block their view in about two minutes.

After the dome was the exit tunnel. According to the narrative this is where the plastic pollution goes back to the human habitat. However, one thing that I discovered was that, after the "death" event – being buried under the trash pile in the dome, there should be a very important moment for the audience to reflect and to internalize what they had experience so far into the experience. This moment of self-reflection is significant since it offers the time and place for the hero to be reborn. However, making this moment part of the looping content in the dome would mean that some audience members will enter the dome and directly go into this reflection moment without even experiencing the "death" event, which I think will weaken the emotional impact for both the "death" moment and the reflection moment.

That was why I decided the make the exit tunnel the space for self-reflection. I wanted to craft a space that takes my audience a step back from the narrative and help them reflect on the problem of plastic pollution. On many levels, I imagined this space to

be more meditative and facilitative, allowing each audience to imagine, interpret, and reflect on their own. A common way I had seen used in places like memorial museums or monuments to encourage people to reflect on their own was to display certain relevant quotes from literature. The quotes, in my opinion, act as a stimulation of discussion, initiate the reflection process inside the viewer by offering them a glance of how other people have considered the issue they are encouraged to consider now. Therefore, I decided to project quotes from *Silent Spring*, an environmental science book by Rachel Carson, onto the walls of the exit tunnel as my way to encourage my audience to reflect on the plastic pollution problem.

The part where the plastic travels back to the human habitat, therefore, needed to be pushed to after the exit tunnel. Instead of spending more and material extending the exit tunnel, I realized that at the end of the installation, my audience will come back to the human habitat anyway, that is the PLAI Lab, the UT campus, the reality they are living in. I wanted to use it as an opportunity to, instead of simply portray scenarios happening somewhere else where plastic reenters human habitat, make this part also a test for my audience. This idea was first suggested by Sven back in September 2018, when he was talking to me about the importance of measuring the level of success for my thesis project and what I can do to measure. Sven mentioned that if the goal for my installation is to change people's attitude and behaviors towards the ocean plastic pollution problem, a good way to measure that would be offering them a test at the end that let them face a choice relevant to the problem, and see how they react. Therefore, I decided to offer my audience bottled water and plastic bag of chips at this final part of the

installation, as a way to gauge if they will still consume products with plastic package after the installation.

Technical Research and Challenges

SPHERICAL PROJECTION

While the design was progressing and I had decided on a geodesic dome as the main physical space for this project, I also started to research into the technical aspect of spherical projection.

Spherical projection (dome projection) refers to the technology of projecting a seamless image across a spherical or a dome surface. It is one of the most crucial parts in my thesis project. I decided to include and investigate this technology into my project because to me by surrounding the audience with 360-degree images, it can create powerful impact on audience senses and therefore potentially evoke stronger emotional response. Also, because the imagery being projected is essentially 360 images or videos, the audience oftentimes experience the story behind the imagery from a first-person perspective, similar to the VR experience when wearing a headset. Telling a story from a first-person perspective can offer the audience a strong sense of subjectivity and personal connection, and therefore evoke emotional responses. Finally, different from wearing a VR headset, a projection mapped dome allows multiple people to experience it at the same time. They can observe and share their response with each other. This sense of communal experience is something I really wanted to keep in this project.

I searched on various websites and investigated projection mapped domes in different scales, from very large scale, large budget, professional dome shows such as *Antarctic Dome* by Obscura Digital, to a much smaller, backyard fun projects realized by hobbyists.

Spherical mapping itself is nothing new for the general public. The most common usage of spherical mapping is the star dome in all planetariums. What I found surprising is that people have attempted to map a dome with projection since early 1900s. However, while the intended outcome stays fairly the same – to map a spherical surface with projection, the quality, the scale, and the approach have changed quite radically through the years. The approaches can be divided into two categories:

(1) Pre-distortion: Utilization of a spherical mirror to distort and reflect the projection onto the dome;

(2) Mirrorless, but using multiple projectors to fully cover the dome, and blend the raster (a raster refers to the rectangular pattern created by digital pixels or light beams from a projector, a computer monitor, or other displays).

The second approach is usually favored to achieve an overall better quality of mapping the inner geometry of a dome due to several reasons:

(1) When using a spherical mirror, the mirror needs to be a front-surface mirror, meaning that instead of having a layer of glass covered on top of a reflective surface like a common mirror, the reflective surface needs to be on top. The reason for this is that since the projection needs to be bounced off the mirror,

having a layer of glass on top will result in double images since the glass layer also reflects light.

(2) To achieve a better result, the mirror usually needs to be put around the center of the dome, which will obstruct audience's path and therefore distract them from the experience.

(3) The spherical surface of the mirror often will cause unwanted artifacts around the edges due to the extreme angle of how the light beams from the projectors hit the surface of the mirror.

(4) For the mirrorless approach, more projectors are often used, which yields better image quality due to larger available resolutions.

However, one of the major advantages of using the mirror approach is that it involves fewer projectors which makes the blending process much easier and cheaper. As one may expect, the key of a successful spherical projection is how well the projection raster are blended together, and that is also the most challenging part.

The main challenge is this : When doing standard projection mapping, whether the mapping is done by manually creating multiple surfaces, or by using a digital 3D model of the mapped object, the calibration process is all done by aligning calibration points in the software to the actual geometry of the physical objects – the calibration points are the corners of a surface or a vertices on a 3D model. However, either way it requires that there are clearly defined physical points on the mapped objects to align to, such as a corner of a building. The challenge of mapping a dome is that the curved and

smooth surface lacking features that can be used as calibration points. This makes it very time consuming and inefficient to align the projection raster on a dome manually.

There are quite a few professional solutions for the problem mentioned above. The most popular and reliable way is best executed by a company called VIOSO. Their solution involves a software system that outputs gray scaled test patterns from each projector and by utilizing a captured image from a camera that analyzes the patterns. Because the projection will appear brighter where projected images overlap, the camera can analyze how the projection rasters are overlapped, and the software automatically calculates the desired calibration. However, as one may expect, this approach is highly technical and costly, which excludes a realistic solution for individual projectionists who cannot afford to pay the commercial-level prices for specialist dome calibration software.

Manual calibration, on the other hand, despite its difficulty, can also be done, and seems to be the most affordable approach for me while at the same time. I also prepared a spherical mirror as a backup.

The software I planned and finally used to manually map my geodesic dome is called TouchDesigner. It is a node-based visual graphical programming environment.

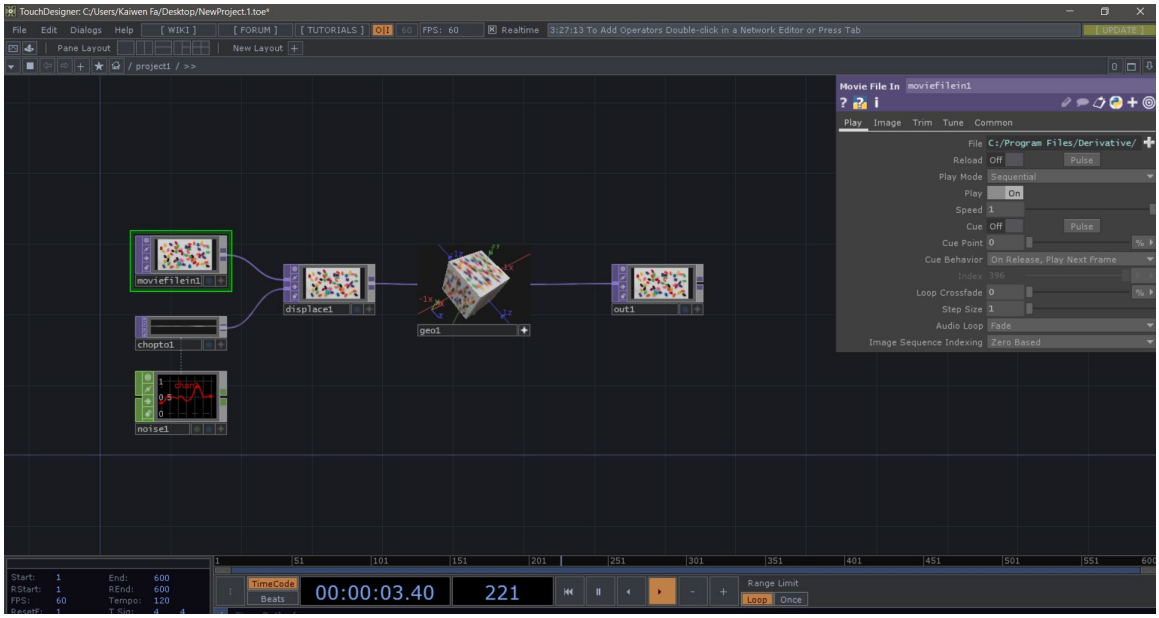

Figure 12: TouchDesigner *Source: Kaiwen Fa*

TouchDesigner allows its users to generate or manipulate images, videos, and sound by running a source file (either a simple rectangle provided inside TouchDesigner, or an image being imported into the software) through a series of nodes. Each node provides the users a number of parameters to change or process what it receives from its input, and output that result in real-time. By combing different nodes into different orders, one can achieve a wide range of fairly sophisticated result in real-time. The reason that TouchDesigner is a visual programming environment is that what is behind each node is essentially a chunk of computer code. TouchDesigner allows its users to essentially write and compile their own code to manipulate input data without having to learn any specific coding languages.

PROJECTION PLOT

The most challenging part in creating the projection plot for this project was to figure out how to adequately project onto the inside surface of the dome. First of all, rear projection was not an option for me, as the physical structure of my geodesic dome would block the projector beams and therefore create the shadows and break the illusion. So, I had to opt for front projection. Second, I wanted to encourage my audience to spend time inside the dome, to move around and experience the projections inside. Therefore, the dome would have to be lifted off the ground. This allowed the projectors to be high enough of the ground so that the audience would not block the beams.

I ended up lifting the dome about 4 feet off the ground. and with the help from staff from the scenic shop at Texas Performing Arts, I was able to reinforce the entire structure to make sure it would pass rigging standards and therefore ensure my audience's safety.

When it came to choose what projectors to use to map my dome, I primarily considered two factors: their lens ratio and their physical footprint. The lens ratio, together with the aspect ratio, determines the shape of my projection beam and therefore how much of a dome surface area one projector can cover, and I needed to have enough overlap across my projection raster while avoiding having too many projectors to blend. Meanwhile, as my dome was lifted off the ground, the projectors need to be lifted 4 feet as well, which meant ideally, they needed to be rigged in a way that would allow me to adjust them as easily as possible during focus. With these considerations in mind, I decided to go with the pico-projectors. They have a 0.8:1 lens ratio, which allows me to

cover the whole dome with five of them, four covering the entire diameter while the fifth one filling up the top of the dome. They are also very lightweight and versatile, which allowed me to mount them on C-stands with easily adjustable magic arms (a kind of portable mount that allows easy adjustment). Later, during focusing, this plan proved to be very effective and efficient.

The tunnels, on the other hand, were mapped with several ultra-short-throw projectors. They have a lens ratio of 0.25:1, which allowed me to cover a huge amount of area by having them two or three feet away from the surface on the floor. In a space as tight as PLAI Lab, they really saved me a lot of space for the actual installation as opposed to having to make space for the projector throw.

Eventually, I reached to this final projection plot:

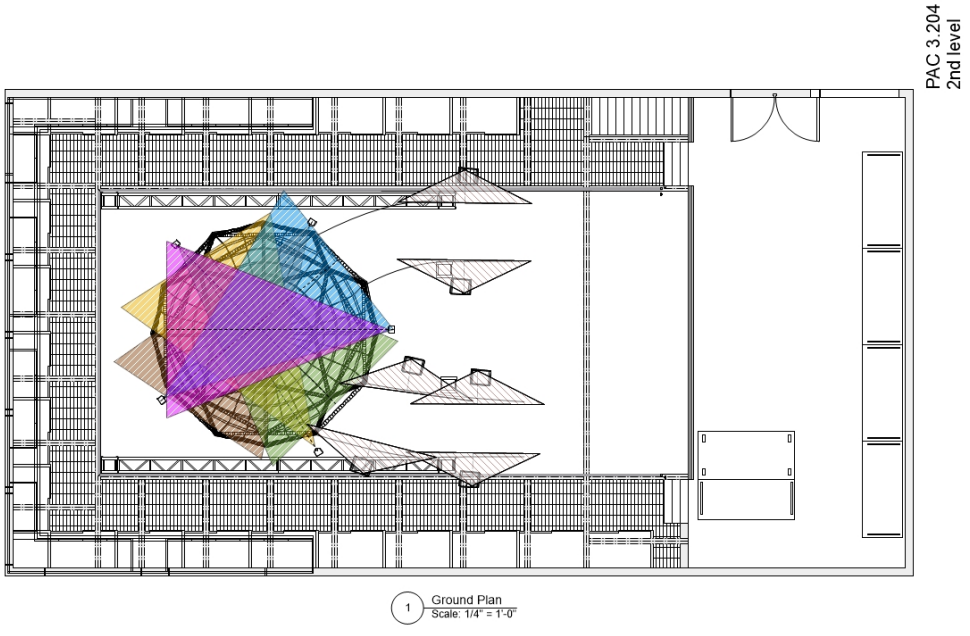

Figure 13: Final projection plot for Polluted Playground *Source: Kaiwen Fa*

REAL-TIME RENDERED GRAPHICS INTEGRATION INTO TOUCHDESIGNER

After setting up the dome structure and the projection system, my challenges shifted to the software side.

As mentioned before, I wanted my audience to be able to interact with the digital content, specifically moving the plastic trash with their hands. While the Leap Motion technology allowed me to get the tracking data from my audience hands, for the content to be interactive, the graphics must be rendered in real-time as opposed to pre-rendered. Only this way that the computer can change the digital content and react to the real-time input data from the audience.

The first challenge I had was to create a believable, real-time rendered ocean scene that was interactive. Knowing that game engines are a kind of software specifically designed for this purpose, and having Michael Bruner on my team, who has been working primarily with Unity, I decided to use game engine Unity 3D to render this part of the narrative scene. Compared to the other major game engine Unreal Engine, Unity is known for its easy integration with outside sources and other software, as it allows scripting in C#.

First and foremost, I needed to have assets to build the 3D scene. While Unity is good for rendering 3D scene in real-time, it is not particularly good at modeling and texturing 3D assets, compared to software like Maya or Blender. The 3D graphics pipeline started with Rogelio and I creating 3D assets in Blender and Maya, as well as purchasing some of the already made assets from an online 3D marketplace such as Unity Assets store and CGTrader.com.

For the 3D assets, we had both animated and still assets. One factor we took into serious consideration when creating or shopping for the 3D assets was that, since they need to be later imported into the game engine and rendered out in real-time, they needed to take as little processing power from the computer as possible. This means (1) the model needed to be composed of as few polygons as possible, without compromising the quality; (2) the animation of the model is more efficient with vertex shaders instead of rigging animation (a vertex shader is a kind of program that runs on the graphic processing unit, GPU, in a computer to move vertices in a 3D model very efficiently); (3) if the model has multiple UV maps, it is better to cut down to one UV map per model. (A UV map in 3D computer graphics is a 2D map that is used to texture a 3D model. It can be considered essentially a "wrapping paper" that wraps around a 3D model that specifies which part of the 2D texture goes onto which part of the 3D model).

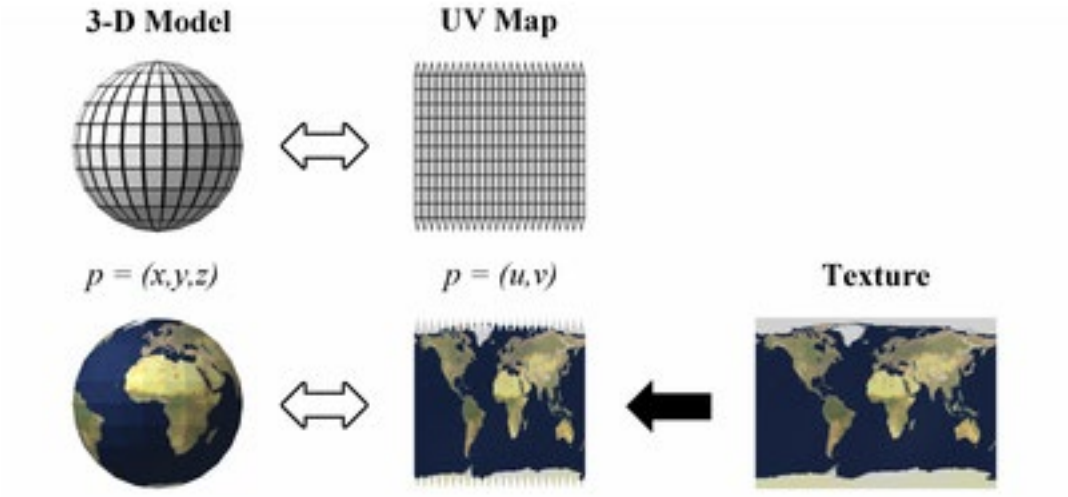

Figure 14: An Explanation of UV Map *Source: en.wikibooks.org*

For the first point – details in 3D models can be achieved in primarily two ways: by having more polygons and therefore more geometry details, or by using textures such as normal maps, specular maps, metallic maps, which are essentially information that tells the computer how lights should react to any given point on the 3D model, and therefore creating visual details without having actual geometry details. The latter is significantly preferred in game development and real time graphics since it can achieve the same level details as the first method with way less burden on the computer.

For the second point – in my case, most of the animation in the scene would be the marine life: fish, plants, sea turtles, etc., all composed in large multiples. This means that I would need to have a lot of animations in the scene. Similar to the challenge of geometry complexity in the first point, I need to figure out a way to have animated 3D models that do not put too much processing burden on the processors. Commonly there are two ways to animate 3D models: skeletal animation and vertex shader animation. While Rogelio and I know skeletal animation, vertex shader animation is significantly faster, cheaper and requires less processing power. Therefore, for the animated models, we searched and purchased low-poly animated models with vertex shader animation.

For the third point – some 3D models can have multiple textures applied to the same geometry by having multiple UV maps associated with one model. This can be advantageous since this essentially creates multiple 3D models (with different textures) from one instance. However, eventually when each individual model gets imported into the game engine, by default they still contain other UV information, which will result in the computer rendering multiple times of the same model because it thinks of it as

multiple models. Therefore, deleting the extra UV information for each individual model after importing into game engine also improves the performance a lot.

After obtaining all the 3D assets, we built the 3D scene in Unity 3D:

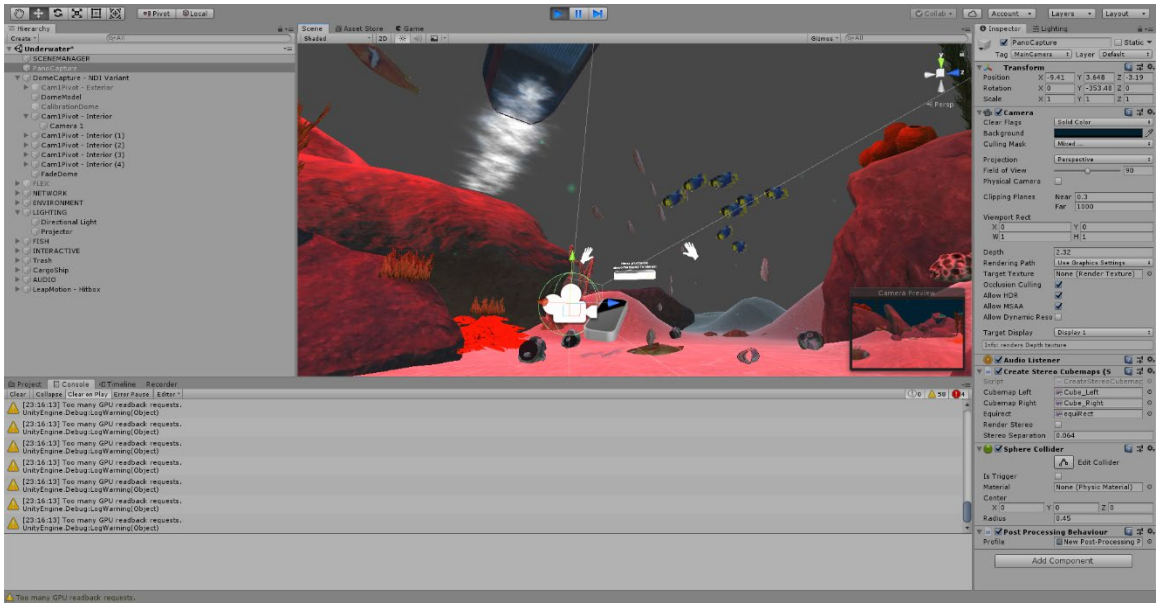

Figure 15: The 3D ocean scene in Unity *Source: Kaiwen Fa*

Next step is the most crucial step in this pipeline: setting up the cameras to render the entire scene into an equi-rectangular map texture, and then apply that texture onto a dome model in Unity:

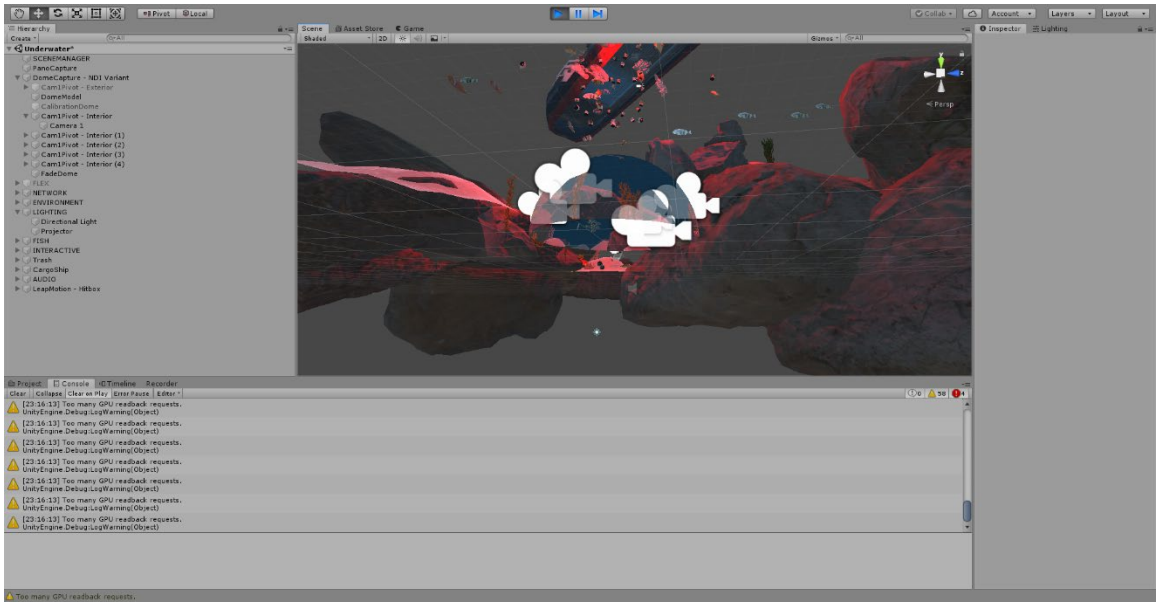

Figure 16: The dome in Unity with the equi-rectangular map texture

Source: Kaiwen Fa

From there, we set up another five virtual cameras in Unity with the approximate same settings as our actual projectors, in terms of lens angle and their relative positions to the dome, and then sent the feed from those five cameras to TouchDesigner via NDI, which is a technology that allows video signal being transmitted across devices (computers in this case) through an ethernet cable.

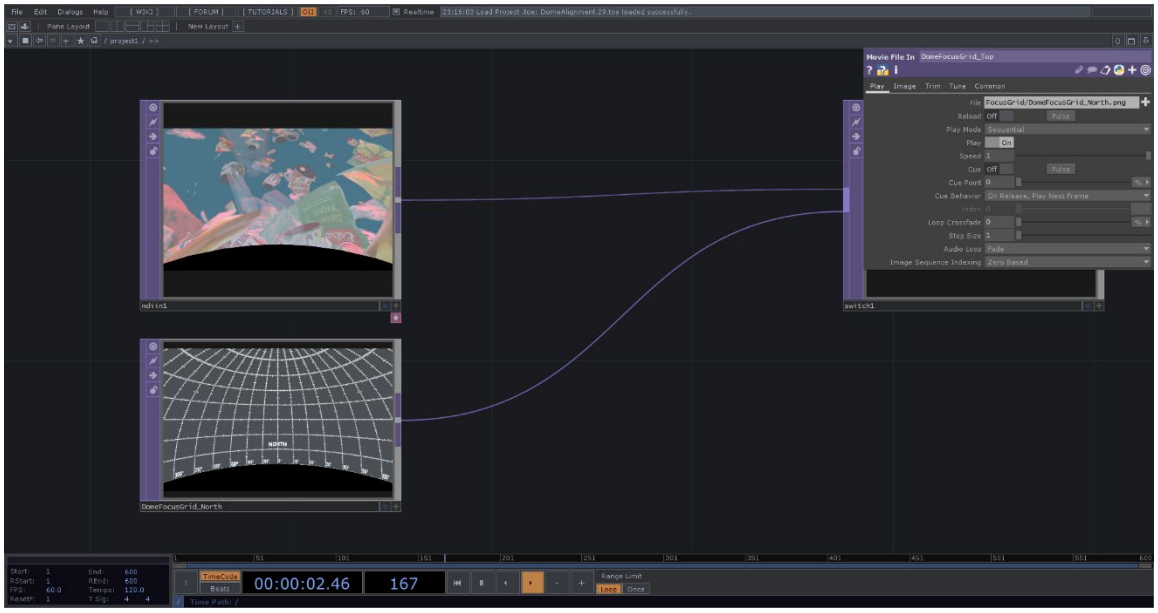

Figure 17: TouchDesigner receiving the NDI Feed from Unity

SPHERICAL PROJECTION WITH TOUCHDESIGNER

The feed from the five virtual cameras was sent out of Unity via NDI, and received by TouchDesigner. TouchDesigner was primarily used as a playback/projection mapping tool, to map the geodesic dome.

As mentioned earlier, considering the technology and budget I had access to, I decided to map the dome manually, meaning manually define and manipulating points to deform the projected images into the correct shapes. For that, I used a built-in tool in TouchDesigner called “stoner”.

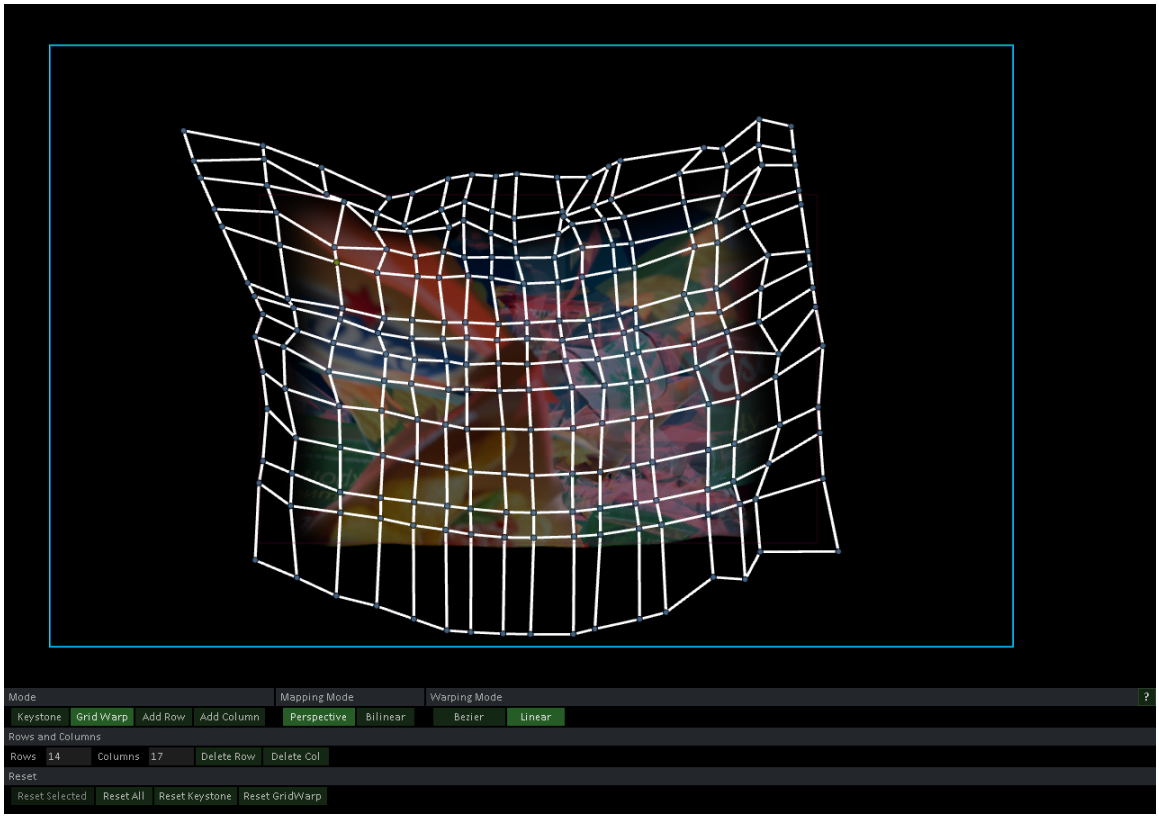

Figure 18: “Stoner” in TouchDesigner allows detailed image distortion

Source: Kaiwen Fa

While the manual calibration of the dome was painstaking, having a corresponding spherical calibration grid helped me a lot. I used this focus grid for my calibration:

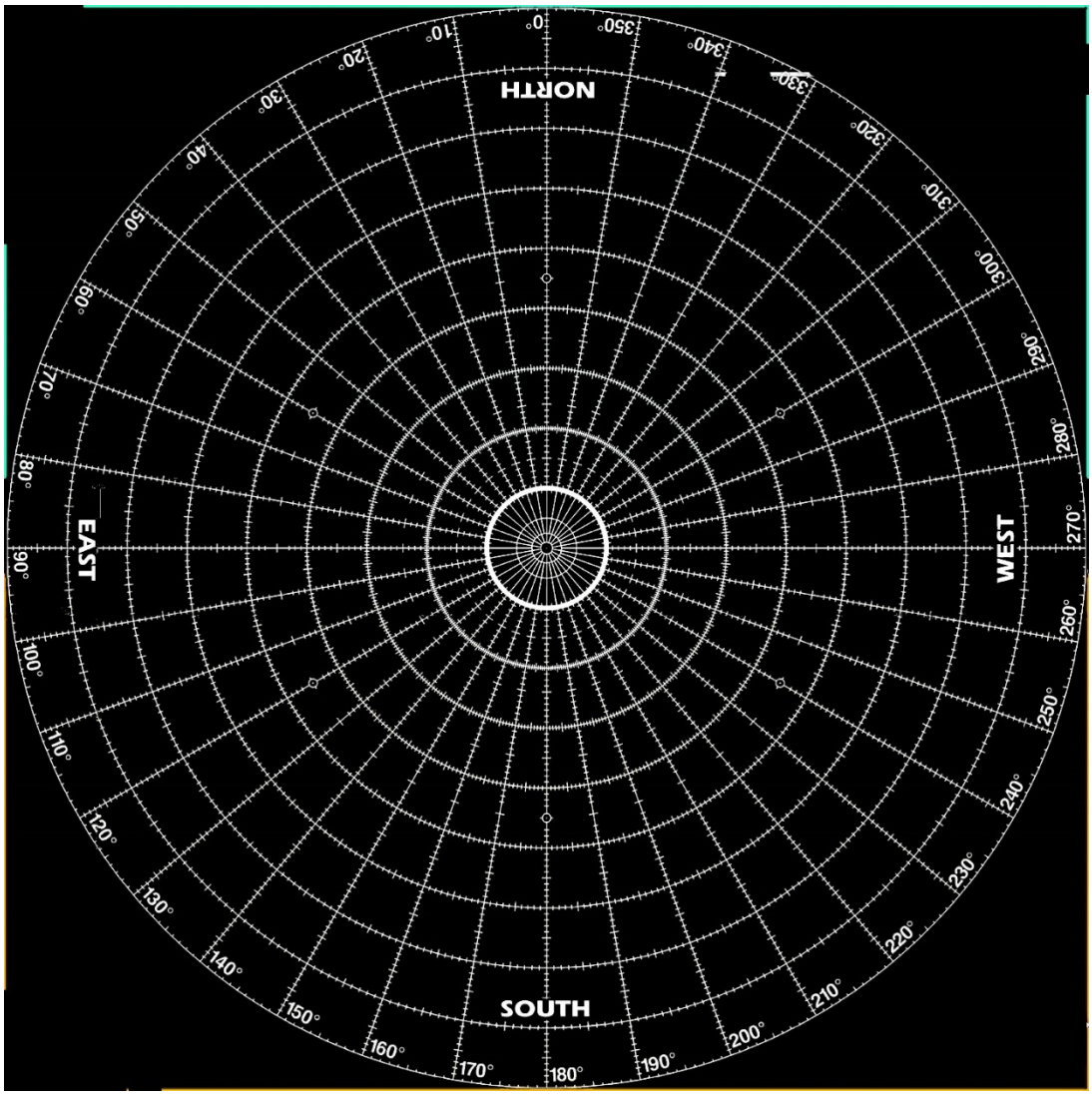

Figure 19: The spherical focus grid I used *Source: spacetheater.worldpress.com*

Another feature I took advantage from is the geodesic nature of my dome. As the base of the dome was in a decagon shape with vertical supports symmetrically placed on each side, I was able to assign certain physical points to their corresponding positions on the dome focus grid and align them first. Having done the focusing process for multiple times, I found this is the best alignment process when one is manually aligning multiple projectors onto a geodesic dome:

(1) Define reference points on the base of the physical structure, so one can know where each quarter of the sphere should land;

(2) Define reference points on the rest of the physical structure, where one can use to define a few correct longitude and latitude lines;

(3) Align the grid for each projector according those physical points first;

(4) Then go from quarter to quarter, align the rest of the grid, trying to maintain the latitude lines parallel to each other and longitude lines equally spaced out;

(5) Align the top of the dome last. If it is a geodesic dome, then there should be a physical point at the top of the dome which can be used for reference. Align the top point first;

(6) Then match the top of the grid with the four quarters.

(7) Refine.

This process can take hours and be tedious, and most important – since whoever is focusing the projectors will be sitting inside the dome – disorienting. Therefore, defining enough physical reference points on the structure is very crucial since one will need to constantly step back and check the focus by looking at the physical reference points.

Here is the diagram that demonstrates the complete graphics working pipeline for this project:

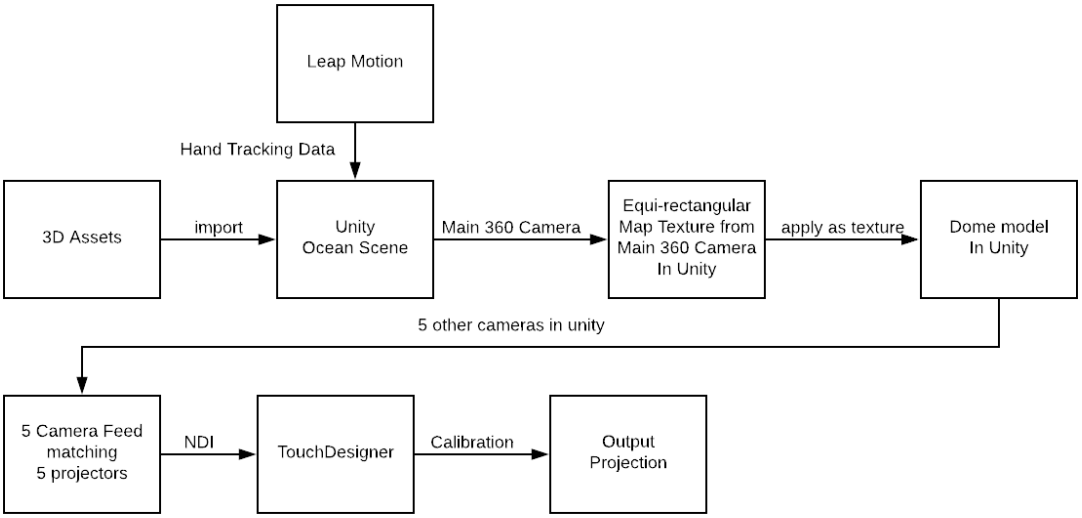

Figure 20: Final graphics working pipeline *Source: Kaiwen Fa*

Chapter 3: Outcome, Reflection, And Looking Forward

Outcome

Figure 21: The final installation of Polluted Playground *Source: Kaiwen Fa*

Figure 22: The final installation of Polluted Playground *Source: Kaiwen Fa*

Figure 23: The final installation of Polluted Playground *Source: Kaiwen Fa*

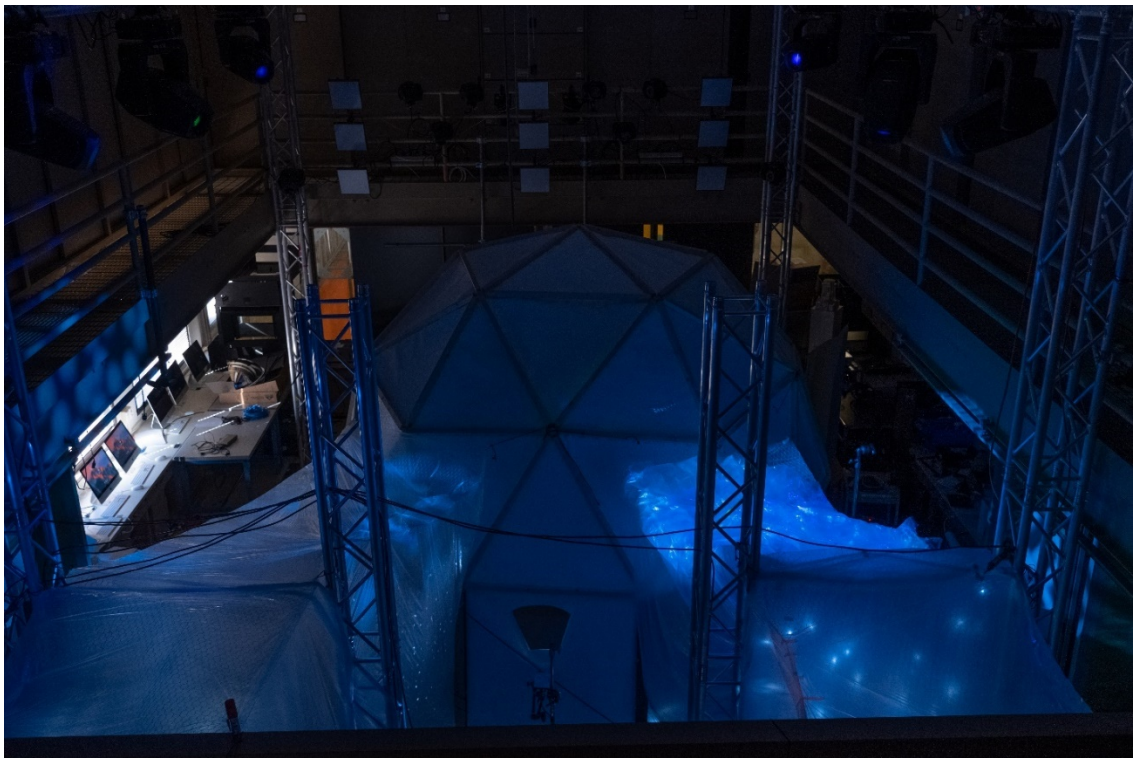

Figure 24: The final installation of Polluted Playground *Source: Kaiwen Fa*

The installation ran for five nights, from January 23rd to 27th, 2019, and about 60 people attended the installation. Among them some came alone and others in groups.

Survey and Revisit the Guiding Questions

At the end of the installation, I offered my audience a survey as the primary way to gauge the outcome of this thesis project. Attached in the appendix is the survey. Approximately 50% of my audience answered my survey, and at the end I received 30 responses. The complete results of my survey are attached in the appendix.

Looking at the result I received from my survey, and revisiting my guiding questions in my abstract, here is what I have learned through this installation:

(1) How can I successfully translate scientific facts into emotional scenarios to engage audiences?

According to my observation and audience's responses, the most successful part of my installation where I deliberately attempt to evoke an emotional response from my audience, was the dome projection. I think there were two reasons for this success. First, the projection dome was the part where the audience were offered with a clear perspective (a fish's view) with which they could identify with. Second, the interactivity reinforced that identity, and therefore established a personal connection. In terms of storytelling, I think the most important part was to have a certain kind of narrative through-line for the audience to follow along, so they can make sense from different information together as a whole.

(2) How can I successfully utilize digital technologies to create an experience that feels accessible?

By deliberately attaching connecting clear meanings to the use of digital technologies. The technology should be the background and facilitate effective communication. All my audience found the dome projection very intuitive and all of them responded very strongly. I received audience responses saying that they felt "fully immersed" inside the dome or they enjoyed "the immersive feeling in the dome space." Some audience members elaborated on their experience in the dome and reported that the perspective of the projection truly made them feel like they are one of the fish

underwater. These responses assured me that I had achieved the sense of immersion in the dome. My audiences were not confused about where they were or who they were when being inside the dome.

(3) How can interactivity be successful in storytelling?

I received, quite interestingly, very polarized response from my audience about the interactive part of my installation. A few of my audience members really enjoyed the hand-tracking interactivity and saying that that was the most interesting part to them, while some others saying that they were not sure at the beginning what they should do with the digital hands other than pushing the trash around, or they got confused by the shape of the size of the digital hands.

I think what was relatively successful in my case was how the interactivity was integrated into the narrative. Most of my audience responded with a sense of excitement and curiosity when they discovered the hand-tracking mechanism, and they responded that with the falling of the trash, they could quickly discover that the trash was interactable. Also, many of my audience responded that they got that they could not stop the trash covering them even though they made the effort. In other words, I think the relationship between the hand-tracking interactivity and the "death" moment was communicated successfully.

Also, I think interactivity in my case was successful in the case that it offered my audience a sense of agency but then immediately challenged that agency to communicate how powerless a marine animal would feel when it is affected by the overwhelming plastic pollution. A number of my audience number responded that they felt powerless

when the trash eventually covered them. This feeling of powerless can only be evoked if I allowed my audience to exert their power somehow in the beginning through interacting with the trash.

On the other hand, what was less successful was that to some of my audience, and on a certain level to myself as well, the interactivity seemed a bit too simple. There was a lack of a clear indication of what the audience should try to achieve with the interactivity. As I mentioned above, some of my teammates suggested that even having a circle or some other target that tells the audience to throw the trash towards would be more helpful.

(4) How does a dome with spherical projection enable user engagement?

I spent a large amount of time inside the dome creating and testing projection content. What I learned about the dome projection was that first of all, spherical projection inherently comes with a sense of perspective as long as any kind of space is being suggested. In other words, unless the projection content is so abstract that it does not suggest any kind of dimensional environment, such as some spherical projection used by VJ, when the projection content offers the audience an idea where they are, it is inevitable to associate an observing perspective. For example, from what angle the 360 content is present matters a lot. In my installation we spent a lot of time trying to match the bottom of the ocean floor in our scene to the horizon line of the physical dome while still showing a little bit of the sand floor. This perspective contributes the illusion that the audience is observing the scene from the perspective a certain marine life that lives on the bottom of the ocean. At one point, my team tried raising the angle higher to the middle of

the water, and we felt that was less of a strong angle, since the camera was not moving, and it is not intuitive to find something sitting perfectly still in the middle of the ocean. Consequently, we found that higher angle to be more confusing than helpful since it does not suggest the existence of an intuitive observant.

Another discovery about spherical projection is that, since it encompasses the full 360 degree of view angle, the framing or composition of a scene has different rules comparing to a rectangular frame (in movies, TVs, or proscenium theater). The strongest parts of the image, we discovered, are around 45-degree latitude, since that's where our eyes naturally go when looking at a dome above our head (only for the case of a dome that is installed above the audience though. In the case of a dome installed on its side in front of the audience, I suspect a different story). Therefore, I chose to put the important information such as the instruction of the how to interact with the hand track at around the 45-degree latitude line.

Visual power distribution also works differently in a dome. Viewing angle, again, becomes one of the major tools to communicate visual power. Because we are completely engulfed inside a dome, anything that appears straight above us will have an inherent dominance, since it quite literally shrouds us and make us feel small and challenged.

OTHER OBSERVATIONS

Along with what I studied and observed in regard to my guiding questions, I also had some other observations I found very helpful.

The first observation is that according to my survey, the least successful part of my installation was quotes projected on the exit tunnel. Many people responded that either they did not feel that the quotes did anything to them, or they had a hard time making the connection between the quotes and the rest of the installation.

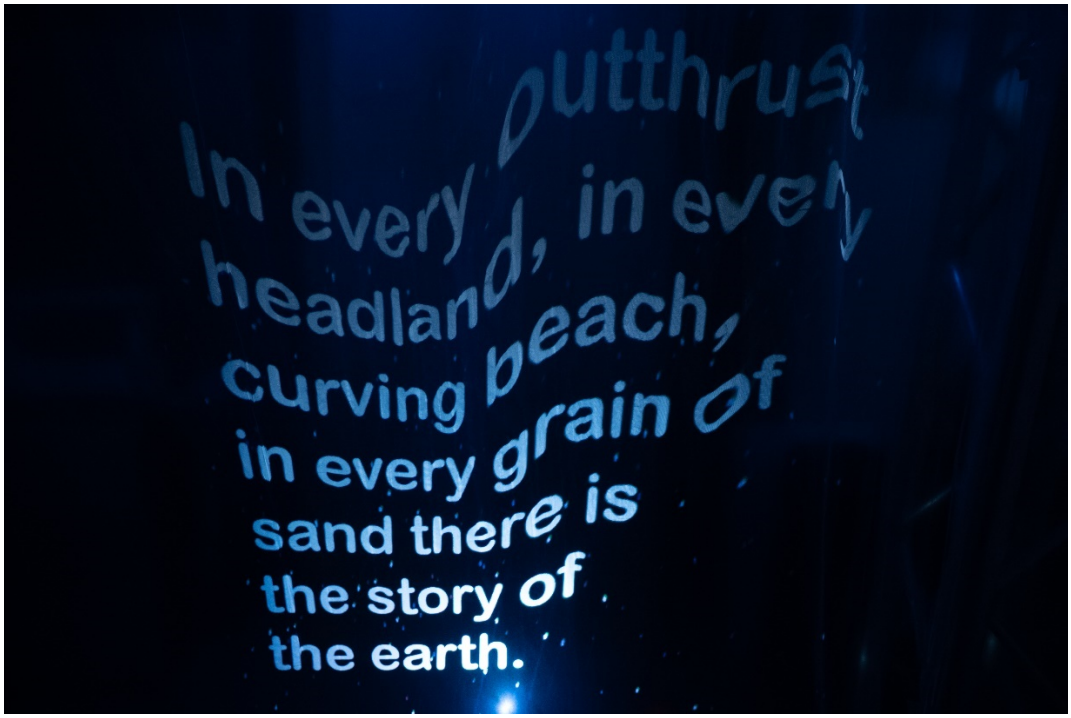

Figure 25: A quote from *Silent Spring* projected onto the plastic wall in my final product. *Source: Kaiwen Fa*

The second observation was that a number of people expressed how their experience of this installation was weakened because they entered the dome near the end of the trash fall. They were either confused or felt that they were given away the end of the plot before they even experienced it.

The third observation goes in some aspects with the second, and it was about how much time people stayed in the dome. While most of my audience stayed there for at

least enough time for the trash video to cycle through once, a few spent less than a minute and completely missed the interactive part of the experience. I talked to some of them about whether they realized that there was more going to happen, and they all responded as they did not. This suggested that it could be because it took too long for the video to cycle through, which matched what I expected. The decision to make the trash video as long as it was (two minutes and thirty seconds) came from my attempt to balance two goals: 1. Giving the trash fall enough time to build up and hence maximize the dramatic effect and 2. Keeping it short enough to avoid that audience loses patience.

Reflection

If I were to do this project again, I think I would do a few things differently:

First of all, the two observations mentioned above both have something to do with the conflict between the self-curated nature of my installation (lack of a cueing system or an usher to guide my audience) and the fact that the narrative I had was deliberatively very linear.

Thinking about it now, I believe this conflict could be resolved in several ways. I think having a kind of cueing system for an installation such as “Polluted Playground” is necessary and may not be as complicated as I expected. What I could have done was to have a group of test audience visit it first, and from that experience figure out how much time it will take on average for a group of audience to go through the entire installation. I could also introduce a sign-up system with time slots that are spaced out based on my test

result, and let only one group of audience go through the experience at once, and cue the video content accordingly.

Second, as for my audience who ran out of patience before the trash fall, I could have offered ways to engage the audience before the trash fall. In this installation, I was expecting that the visual spectacle of the spherical projection would be enough to engage my audience through the first one minute and thirty seconds. However, in terms of the video content itself, there was not much narrative or activity happening during that ninety seconds. Thinking about it now, some simple interactivity would be enough, such as if an audience follows an on-screen instruction and waves their hands around above the hand tracker, the fish school would change direction, or be attracted to their hands. The ocean scene in Unity I had in this project was a bit too unresponsive. Considering my audience was standing inside a dome experiencing the visual narrative from the perspective of a marine animal, having a passive, unchangeable scene made the experience a little lifeless.

Third, I think the quotes I chose to project on the exit tunnel were a bit too ambiguous, and most importantly lacked other information to help audience find connections with the rest of the installation. If I were to this installation again, I may consider overlaying the real world footage of a polluted beach filled with plastics, marine animals get tangled or choked to death by the plastic wastes, and maybe bottled water with plastic bits in them to illustrate that the plastic particles will eventually re-enter our food system.

On the other hand, I felt overall very grateful that I had this opportunity to produce this installation in graduate school. This process challenged me not only as a

media designer but as an experience designer, an artistic director, and a producer, allowed me to consider design from a higher perspective, and learned how much it takes to produce a project in this scale. It has offered an invaluable opportunity to grow as an artist in both thinking, crafts, and producing.

Looking forward, I am eager to keep developing on this project. Besides what I have mentioned above, this experience has made me wonder – would this installation be more successful if I do try to find a more localized problem for my audience? If I had multiple domes, would I be able to address multiple environmental problems and make the experience a larger, more diverse "polluted playground"?

Appendix (or Appendices)

1. QUESTIONNAIRE

What is your attitude towards the usage of plastic products in our societies before you see this installation?

Which part of this installation you find most interesting?

Which part of this installation you think that's the least successful one(s) to you?

After you saw this installation, do you feel that it alters your attitude towards the particular environmental issue, or any other environmental issues at all?

Anything else you want to say?

2. 360° VIDEO OF THE DOME PROJECTION

https://www.youtube.com/watch?v=zpbbqFs2mgQ&t=102s

Reference

"Artists & Climate Change." Edited by Chantal Bilodeau, *Artists & Climate Change*, artistsandclimatechange.com/.

"Blender 3D: Noob to Pro/UV Map Basics." *Blender 3D: Noob to Pro/UV Map Basics - Wikibooks, Open Books for an Open World*, en.wikibooks.org/wiki/Blender_3D:_Noob_to_Pro/UV_Map_Basics.

"Change Consumption Habits to Help the Environment." *SFJ - Sqfeed Journal*, 23 Mar. 2018, www.sqfeed.com/2018/03/23/in-the-report-recycling-can-be-too-much-of-a-good-thing-mar-17-the-authors-talk-of-the-ills-of-recycling-procedures-i-agree-that-recycling-is-packaged-as-a-convenient-and-cure-all-method-to-mitig/.

Denchak, Melissa. "Water Pollution: Everything You Need to Know." *NRDC*, 22 Apr. 2019, www.nrdc.org/stories/water-pollution-everything-you-need-know#causes.

Feeldesain. "The Minimum Monument Project by Nèle Azevedo." *Feel Desain | Your Daily Dose of Creativity*, 6 Feb. 2013, www.feeldesain.com/the-minimum-monument-project-by-nele-azevedo.html.

"Hero's Journey." *Wikipedia*, Wikimedia Foundation, 27 Apr. 2019, en.wikipedia.org/wiki/Hero's_journey.

"How to Project in a Dome." *Domerama*, www.domerama.com/general/geodesic-dome-projection/how-to-project-in-a-dome/.

"Introduction to Fulldome – Attention Producers!" *Transforming the Heikoff Dome Theater*, 29 Jan. 2016, spacetheater.wordpress.com/introduction-to-fulldome-attention-producers/.

K.sina.com.cn - 新浪看点. k.sina.com.cn/.

"Plastic Pollution Guide - Ocean Pollution Facts & Figures." *SLO Active*, 29 Apr. 2019, sloactive.com/plastic-pollution/.

"Pollution Pods." *Climart*, www.climart.info/pollutionpods.

Quevillon, Francois. "Dérive." *François Quévillon*, 8 Apr. 2019, francois-quevillon.com/w/?p=380.

Rabbit, Meg. "Leap Motion, Proprioception, and the Jenga Test." *Lumo Interactive*, Lumo Interactive, 18 Feb. 2016, lumointeractive.com/lumo-daily-inspiration/2016/2/17/leap-motion-proprioception-and-the-jenga-test.

"Tan Zi Xi." *Oceanic Global*, 28 Mar. 2017, oceanic.global/tan-zi-xi/.

"The Antarctic, Powered by HP, Coachella 2017." *Obscura Digital*, obscuradigital.com/work/antarctic-dome-coachella-2017/.

"鲁网文旅频道 - 山东文旅门户网站 - 山东文化和旅游新闻 - 山东旅游新闻网." *鲁网文旅频道 - 山东文旅门户网站 - 山东文化和旅游新闻 - 山东旅游新闻网*, t.sdnews.com.cn/.